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## Description

The present invention relates to a method of packaging detonating cord in such a manner that spontaneous detonation of the cord at one point does not propagate to the entire cord. The invention also relates to a support for implementing the method, and to the resulting package.

Explosive substances must be capable of being stored in complete safety and also of being transported quickly to sites such as oil production or exploration sites. They must be capable of being transported by air, in particular. International regulations define classes for explosive substances, and at present detonating cords are in a class for which air transport is banned. In general, when a detonating cord wound in a reel detonates, it detonates completely and produces major blast effects which are incompatible with air transport safety.

The invention seeks to provide a packaging method making it possible to prevent a local detonation to propagate. This packaging should be simple and inexpensive, unlike the packaging proposed in US-A-4,586,602 where crossover points are established that interrupt the propagation of a detonation by virtue of separator means.

According to a first aspect of the present invention, there is provided a method of packaging a detonating cord comprising explosive material contained in a sheath, said method comprising the step of winding the detonating cord on a support in such a manner that every portion of the detonating cord in the winding is spaced apart from the nearest portions which are substantially parallel thereto by a distance  $a$  lying in the range between the distance below which detonation is transmissible from one portion to the nearest portion, and the distance beyond which said containing sheath is no longer destroyed by the detonation of a nearest portion.

It has been discovered that for some cords, in particular transmission cords, the energy required for destroying the containing sheath is less than the energy required for igniting detonation. The invention is based on this discovery. In order to prevent detonation of a reel of cord as a whole, it is necessary firstly to prevent ignition propagating by the influence of the detonation of one strand, and secondly to interrupt the continuity of the cord in order to stop detonation propagating along the cord. This is achieved by the destruction of the containing sheath, which advantageously takes place at an energy threshold which is relatively low and which is far enough below the threshold that would lead to the detonation propagating by influence.

If the cord is wound in layers, the method of the invention advantageously includes a step of winding a spacer cord of inert material simultaneously with the detonating cord, said material forming intermedi-

ate turns between adjacent turns of detonating cord.

In a second aspect, the invention provides a safety support for making a reel of detonating cord, the support comprising two end plates spaced apart by at least two series of parallel strips, each series defining a support for one layer of the reel and positioning that layer such that each layer of the reel is substantially parallel to the adjacent layers and is spaced apart therefrom by a predetermined distance  $a$ , as defined in claim 3.

In one embodiment of this support, the strips are notched so as to fix the position of each turn in a layer and its distance from its neighbors.

For supports which can be recovered, the strips belonging to series other than the series constituting the support for the innermost layer are removably fixed to the side plates. In any event, a layer can only be wound in the absence of the strips for supporting layers further out than the layer being wound. Thus regardless of whether they are removably fixed or not, the strips must be installed while the reel is being wound.

With such a support, the turns of detonating cord in a layer are suitably isolated from one another by winding intermediate turns of a spacer cord. This cord may be made of plastic and preferably hollow i.e. tubular in cross-section. Its outside diameter will depend on the type of detonating cord being packaged. In general it will lie in the range 5 millimeters to 10 millimeters. Naturally, the substance from which the spacer cord is made (a plastic) is sufficiently frangible to ensure that it creates only a minor obstacle to a shock wave starting from any point of detonation, whereby the containing sheath of the nearest turn of detonating cord will be destroyed before the detonation front reaches the nearest turn of detonating cord as the detonation front moves along the cord.

A package according to the invention can be made up on a conventional reel, and thus on a reel which satisfies safety regulations, by using alternating coiled layers, with one type of layer being made up solely of touching turns of the intermediate spacer cord, while layers of the other type are constituted by alternating turns of spacer cord and detonating cord. It is thus possible to achieve a distance between the turns of detonating cord as specified above for obtaining the desired result of preventing detonation of the entire cord.

The invention will be better understood from the following description of several embodiments of the invention.

Reference is made to the accompanying drawings, in which:

Figure 1 is a diagrammatic radial section through a reel of detonating cord made in accordance with the invention;

Figure 2 is an axial section through a reel similar to that shown in Figure 1;

Figure 3 shows a variant embodiment of the strip used in the preceding figures; and

Figures 4 and 5 are a radial section and an axial section through a second reel made in accordance with the invention.

With reference initially to Figures 1 and 2, a reel 1 can be seen comprising two end plates 2 and 3 spaced apart by two series A and B of strips 4. Each series A, B of strips constitutes a support on which alternating touching turns of detonating cord 6 and tubular spacer cord 7 are wound. The function of the spacer cord 7 is to maintain the spacing a between adjacent turns of detonating cord 6. In addition, the radial spacing between two series A and B of strips serves to maintain successive layers 8 and 9 similarly spaced apart by a distance which is approximately equal to a. By this particular mode of winding, it is ensured that any portion of the detonating cord is at a distance a from the nearest parallel portion such that the distance a lies between the distance below which detonation would propagate from one portion of the detonating cord to another and the distance beyond which the containing sheath 6a which surrounds the explosive material of the cord is not destroyed. It will be recalled that detonating cords are generally constituted by an explosive protected by a sheath which includes a braid of jute cloth surrounded by a layer of plastic material, e.g. nylon, which forms the outer portion of the sheath.

Naturally, the distance a varies in accordance with the nature and the diameter of the detonating cord, and it may be established experimentally.

By way of example, for flexible transmission cords used in mines, quarries, and oil wells, this distance is about 5 millimeters to 10 millimeters. The tubular cord 7 which maintains the spacing between the turns of detonating cord is thus a tube of plastic (e.g. polyvinyl chloride) having an outside diameter of about 5 millimeters and an inside diameter of about 3 millimeters.

The strips 4 are made of any suitable material (e.g. wood), and they are in such number that the layers are adequately supported. The end plates and the strips may constitute returnable packaging or non-returnable packaging. In any event, means need to be provided for enabling the strips other than those belonging to the innermost series A to be fixed to the end plates so as to enable the various layers to be wound. A layer can only be wound so long as the strips for supporting layers further out than the layer being wound are absent. Any appropriate type of fixing means may be used, including dismountable types and types which are not dismountable, depending on whether or not the support constitutes returnable packaging. Thus, for example, the side plates 2 and 3 may have radial grooves for receiving strips 4 provided with retaining heads and grooves at their ends.

Figure 3 shows a variant 5 of the strip 4 which includes notches 10 for enabling cord 6 to be wound in non-touching turns which are spaced apart by the distance a without it being necessary to use intermediate turns of spacer cord.

Figures 4 and 5 show that a substantially equivalent result can be obtained using a conventional reel 11 including a mandrel 12. The detonating cord 6 is wound together with hollow spacer cord 7 in such a manner as to ensure that adjacent turns of detonating cord are separated by intermediate turns of spacer cord, and that adjacent layers 13 including detonating cord are separated by intermediate layers 14 constituted by touching turns of spacer cord only.

### Claims

1. A method of packaging a detonating cord comprising explosive material contained in a sheath, said method comprising the step of winding the detonating cord on a support in such a manner that every portion of the detonating cord in the winding is spaced apart from the nearest portions which are substantially parallel thereto by a distance a lying in a range between the distance below which detonation is transmissible from one portion to the nearest portion, and the distance beyond which said containing sheath is no longer destroyed by the detonation of a nearest portion.
2. A method according to claim 1, wherein in order to maintain the above-mentioned spacing between adjacent portions of the detonating cord in the same layer, the detonating cord is wound with intermediate turns of a spacer cord whose diameter is related to said distance a.
3. A safety support for a reel of detonating cord (6), said cord comprising explosive material contained in a sheath (6a), the support comprising two end plates (2,3) spaced apart by at least two series (A,B) of parallel strips (4), each series defining a support for one layer of the reel and positioning that layer such that each layer of the reel is substantially parallel to the adjacent layers and is spaced apart therefrom by a predetermined distance a lying in a range between the distance below which detonation is transmissible from one portion to the nearest portion of the detonating cord (6), and the distance beyond which said containing sheath (6a) of one portion of the detonating cord is no longer destroyed by the detonation of a nearest portion, the strips in each layer being adapted to enable the detonation cord to be spaced apart by a distance lying in said range.
4. A support according to claim 3, wherein each strip

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(4) is notched, with the distance between notches (10) defining the spacing a between the portions of detonating cord in each layer.

5. A support according to claim 3 or claim 4, wherein at least those strips which belong to series other than the series constituting the support for the innermost layer are fixed to the end plates removably.
6. A safe reel of detonating cord, comprising a support according to claim 5 on which each layer is formed with alternating touching turns of detonating cord (6) and intermediate spacer cord (7).
7. A safe reel of detonating cord (6), the cord comprising explosive material contained in a sheath, said reel comprising a plurality of touching layers (13,14) wound on a mandrel (12), the layers alternating between layers (13) constituted by touching turns of intermediate spacer cord (7) of predetermined diameter, and layers (14) constituted by an alternating succession of turns of detonating cord (6) and of intermediate spacer cord (7), the diameter of said spacer cord (7) being such that every portion of the detonating cord (6) in the reel is spaced apart from the nearest portions of detonating cord which are substantially parallel thereto by a distance a lying in a range between the distance below which detonation is transmissible from one portion to the nearest portion, and the distance beyond which said containing sheath is no longer destroyed by the detonation of a nearest portion.
8. A safe reel according to claim 7, wherein said spacer cord (7) is tubular.

#### Patentansprüche

1. Ein Verfahren zum Verpacken einer Zündschnur, umfassend explosives Material, das in einer Ummantelung enthalten ist, welches Verfahren den Schritt umfaßt, die Zündschnur auf einen Support derart aufzuwickeln, daß jeder Abschnitt der Zündschnur in der Wicklung von den nächstgelegenen Abschnitten, die im wesentlichen parallel dazu verlaufen, um eine Distanz a beabstandet ist, die in einem Bereich liegt zwischen der Distanz, unterhalb welcher die Detonation von einem Abschnitt zu dem nächstverlaufenden Abschnitt übertragbar ist, und der Distanz, über welche hinaus die Ummantelung nicht mehr durch die Detonation eines nächstgelegenen Abschnitts zerstört wird.
2. Ein Verfahren nach Anspruch 1, bei dem zwecks

Aufrechterhaltung des oben genannten Abstandes zwischen benachbarten Abschnitten der Zündschnur in derselben Lage die Zündschnur mit dazwischenliegenden Windungen einer Abstandsschnur, deren Durchmesser in Beziehung zu der Distanz a steht, aufgewickelt wird.

3. Ein Sicherheitssupport für einen Wickel aus Zündschnur (6), welche Zündschnur explosives Material, enthalten in einer Ummantelung (6a), umfaßt, welcher Support zwei Endplatten (2,3) umfaßt, die voneinander durch mindestens zwei Serien (A,B) von parallelen Streifen (4) beabstandet sind, wobei jede Serie einen Support für eine Lage des Wickels bildet und jene Lage derart positioniert, daß jede Lage des Wickels im wesentlichen parallel zu den benachbarten Lagen ist und davon um eine vorbestimmte Distanz a beabstandet ist, welche in einem Bereich liegt zwischen der Distanz, unterhalb welcher die Detonation von einem Abschnitt des nächstgelegenen Abschnitts der Zündschnur (6) übertragbar ist, und der Distanz, über welche hinaus die Ummantelung (6a) von einem Abschnitt der Zündschnur nicht mehr zerstörbar ist durch die Detonation des nächstgelegenen Abschnitts, wobei die Streifen in jeder Lage ausgebildet sind zum Ermöglichen der Detonationsschnur voneinander um eine in dem genannten Bereich liegende Distanz beabstandet zu sein.
4. Ein Support nach Anspruch 3, bei dem jeder Streifen (4) mit Ausnehmungen versehen ist, wobei der Abstand zwischen Ausnehmungen (10) den Abstand a zwischen den Abschnitten der Zündschnur in jeder Lage definiert.
5. Ein Support nach Anspruch 3 oder Anspruch 4, bei dem mindestens jene Streifen, die zu Serien gehören außer jener, welche den Support für die innerste Lage bilden, an den Endplatten abnehmbar befestigt sind.
6. Ein Zündschnur-Sicherheitswickel, umfassend einen Support nach Anspruch 5, bei dem jede Lage mit alternierenden, berührenden Windungen von Zündschnur (6) und zwischenliegender Abstandsschnur (7) gebildet ist.
7. Ein Zündschnur-(6)-Sicherheitswickel, wobei die Zündschnur explosives Material, enthalten in einer Ummantelung, umfaßt, welcher Wickel eine Mehrzahl voneinander berührenden Lagen (13,14), aufgewunden auf einen Dorn (12), umfaßt, wobei die Lagen zwischen Lagen (13), bestehend aus berührenden Windungen von Zwischendistanzsnur (7) vorbestimmten Durchmessers, und Lagen (14) alternieren, gebildet

von einer alternierenden Abfolge von Windungen von Zündschnur (6) und Zwischenabstandsschnur (7), wobei der Durchmesser der Abstandsschnur (7) derart ist, daß jeder Abschnitt der Zündschnur (6) in dem Wickel von den nächstgelegenen Abschnitten der Zündschnur, die im wesentlichen parallel dazu verlaufen, um eine Distanz  $a$  beabstandet ist, die in einem Bereich liegt zwischen der Distanz, unterhalb welcher die Detonation übertragbar ist von einem Abschnitt zum nächstgelegenen Abschnitt, und der Distanz, über welche hinaus die Ummantelung nicht mehr durch die Detonation eines nächstgelegenen Abschnitts zerstört wird.

8. Ein Sicherheitswickel nach Anspruch 7, bei dem die Abstandsschnur (7) rohrförmig ist.

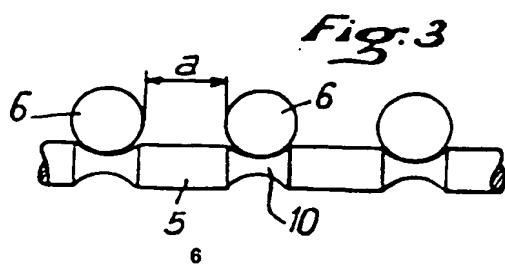
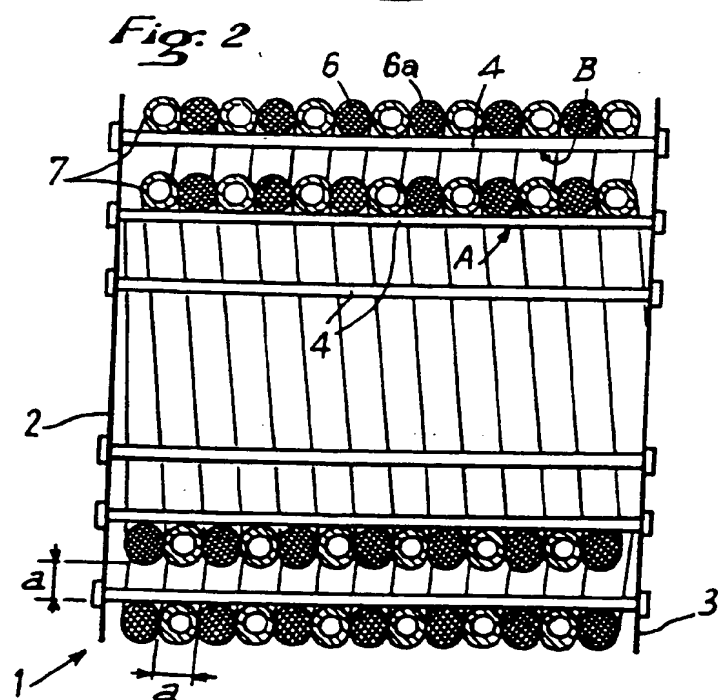
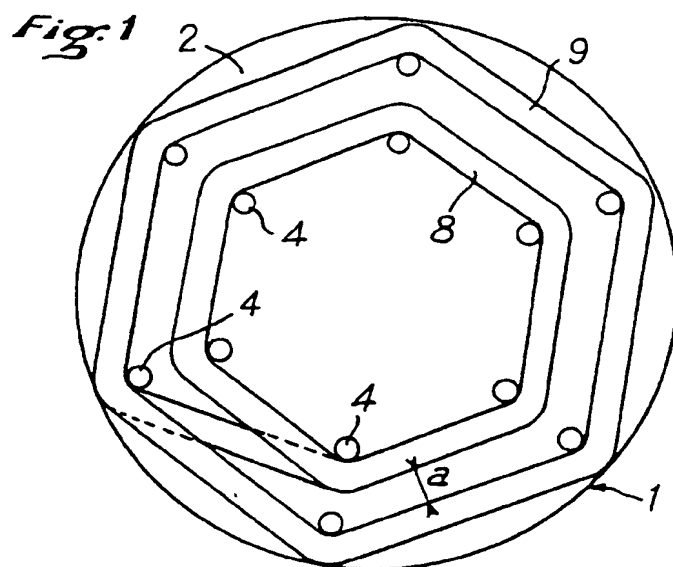
#### Revendications

1. Procédé pour emballer un cordeau explosif comportant une gaine de contention du produit explosif, caractérisé par le fait qu'on réalise un enroulement du cordeau sur un support de manière qu'une quelconque portion de cordeau de l'enroulement soit écartée des portions adjacentes qui lui sont sensiblement parallèles, d'une distance ( $a$ ) comprise dans une plage située entre la distance en deçà de laquelle la détonation est transmissible d'une portion à la portion voisine, et la distance au delà de laquelle la gaine n'est plus détruite par la détonation d'une portion voisine.
2. Procédé selon la revendication 1 dans lequel, pour maintenir l'écartement susdit au moins entre les portions de cordeau voisines dans une même couche, on réalise l'enroulement du cordeau avec des enroulements intercalaires d'un cordon d'écartement dont le diamètre est en relation avec la valeur ( $a$ ).
3. Support de sécurité pour une bobine de cordeau explosif (6), ledit cordeau comprenant une gaine de contention (6a) du produit explosif, caractérisé par le fait qu'il comporte deux flasques (2,3) entretroisées par au moins deux séries (A,B) de réglettes parallèles (4), chaque série définissant le support d'une couche de la bobine et sa position de manière que chaque couche de la bobine soit sensiblement parallèle aux couches voisines et écartée de celles-ci d'une distance ( $a$ ) prédéterminée comprise dans une plage située entre la distance en deçà de laquelle la détonation est transmissible d'une portion à la portion voisine du cordeau détonant (6a), et la distance au delà de laquelle la gaine n'est plus détruite par la détonation d'une portion voisine, les portions de cor-

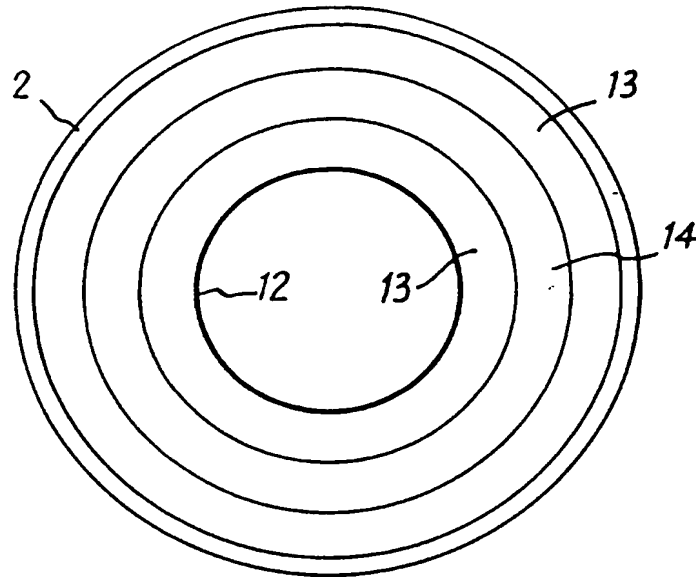
deau détonant dans chaque couche étant écartées d'une distance située dans ladite plage.

4. Support selon la revendication 3, dans lequel chaque réglette (4) est encochée, la distance entre encoches (10) définissant l'écartement ( $a$ ) des portions de cordeau détonant dans chaque couche.
5. Support selon la revendication 3 ou la revendication 4, dans lequel au moins les réglettes appartenant aux séries autres que la série formant support pour la couche intérieure sont fixées de manière amovible aux flasques.
6. Bobine de sécurité de cordeau explosif comportant un support selon la revendication 5 sur lequel chaque couche est formée, à spires jointives, par l'alternance d'une spire de cordeau (6) et d'une spire de cordon intercalaire (7).
7. Bobine de sécurité de cordeau explosif (6) comprenant une gaine de contention du produit explosif, caractérisée par le fait qu'elle comporte, enroulées sur un mandrin (12), une pluralité de couches (13,14) formée par l'alternance de couches (13) constituées d'un enroulement à spires jointives d'un cordon intercalaire (7) de diamètre déterminé et de couches (14) constituées par une succession alternée de spires de cordeau détonant (6) et de cordon intercalaire (7), le diamètre de ce cordon (7) étant tel qu'une quelconque portion de cordeau de l'enroulement soit écartée des portions adjacentes qui lui sont sensiblement parallèles d'une distance ( $a$ ) comprise dans une plage située entre la distance en deçà de laquelle la détonation est transmissible d'une portion à la portion voisine, et la distance au delà de laquelle la gaine n'est plus détruite par la détonation d'une portion voisine.
8. Bobine de sécurité selon la revendication 7, dans laquelle le dit cordon intercalaire (7) est tubulaire.

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*Fig. 4**Fig. 5*